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Testing Proof of Concept of a Web-Based Ship Manoeuvring Training Tool in the Classroom

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Abstract - **Currently, real-time ship manoeuvring simulations are confined to static environments e.g., desktop/full-mission bridge simulators. *Seaman Online*™ is a novel web-based ship manoeuvring training tool allowing students and professional mariners to practice manoeuvres in ports and confined waters from their personal computers. This paper describes the tool's first-time implementation in a Master Mariner university programme. The students were asked to complete a post-questionnaire regarding their use experience and the results were discussed between the course instructors and the tool-providing organization at two debriefings. The aim was to obtain feedback about (a) the usefulness of the tool in manoeuvring training; (b) further design improvements and usability; and (c) how to best incorporate it into the programme curriculum in coming academic years for improved user experience. Results revealed usability and maturity issues and the need for further guidance on simulation-based training objectives and limitations. Overall, the tool's usefulness and potential in individual manoeuvring training were demonstrated.**

Keywords
Navigation, manoeuvring, e-learning, simulation, usability.

INTRODUCTION

The maritime sector is a complex, dynamic and safety-critical domain (Costa, 2018; da Conceição, Dahlman, & Navarro, 2017; Grech, Horberry, & Koester, 2008; Lützhöft & Vu, 2018; Manuel, 2011). Ship manoeuvring, in particular, may be defined as a complex physics problem with a large number of parameters and forces involved (Baudu, 2014). Although these parameters and forces and their effects may be mathematically described, mariners will hardly have the opportunity to do any calculations during manoeuvring operations and will thus need to rely on their understanding, knowledge and experience of ship handling. Whilst lectures and text books provide the theoretical background, simulation exercises will, to a certain extent, give the trainees first-hand practical training in ship manoeuvring.

Simulation is an educational – or recreational – technique that allows mimicking all or part of a real-life activity in a controlled environment, at a low to high fidelity level (i.e., how well the simulation replicates reality), without the risks that a real-life setting would entail (Beaubien & Baker, 2004; Maran & Glavin, 2003). The use of simulators (i.e., artefacts/facilities that embody the simulation) in the training and assessment of mariners is endorsed by the International Maritime Organization's (IMO) Standard of Training, Certification and Watchkeeping for Seafarers (STCW) (IMO, 2017). Nautical simulation-based training helps to learn ships' reactions and behaviours (Baldauf & Benedict, 2018) and allows for testing safety-critical activities in a risk-free (Beaubien & Baker, 2004; Maran & Glavin, 2003; Sellberg, 2018) and more cost-effective environment (Sellberg, 2018). Another advantage of simulation-based training is the possibility for the instructors to tailor exercises to specific situations and learning objectives (Maran & Glavin, 2003; Sellberg, 2018) and/or to the experience or performance of the trainees (Sellberg, 2018).

There are different simulation technologies and at different levels of fidelity. They can contribute to developing technical and/or managerial, communication or teamwork skills differently (Maran & Glavin, 2003). Some simulation technologies replicate only part of a task and/or have simplified representations of a real environment. These are normally considered of low fidelity (e.g., desktop-based simulations). Other simulation technologies duplicate a whole environment where team situations can also be tested, and/or replicate a real-life environment more realistically, and hence are considered of high fidelity (e.g., a full-mission ship bridge simulator). The degree of fidelity, however, does not determine the effectiveness or success of the learning outcomes (Hamstra,

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Brydges, Hatala, Zendejas, & Cook, 2014). The outcomes depend on the learning objectives, the competencies that are to be developed, and how simulation can be used for these purposes (Dahlström, Dekker, van Winsen, & Nyce, 2009; Maran & Glavin, 2003; Sellberg, 2018).

Ship Manoeuvring Training Tool Seaman Online™

Currently, virtually all real-time ship manoeuvring simulations are confined to static environments such as desktop or full-mission (3D) simulators. *Seaman Online™* (see Figure 1) is a novel ship manoeuvring training tool that offers high availability and flexibility by being web-based and requiring solely a personal computer and an internet connection for both students and professional mariners to individually have access to simulation-based training and safely practice manoeuvres in ports and confined waters.

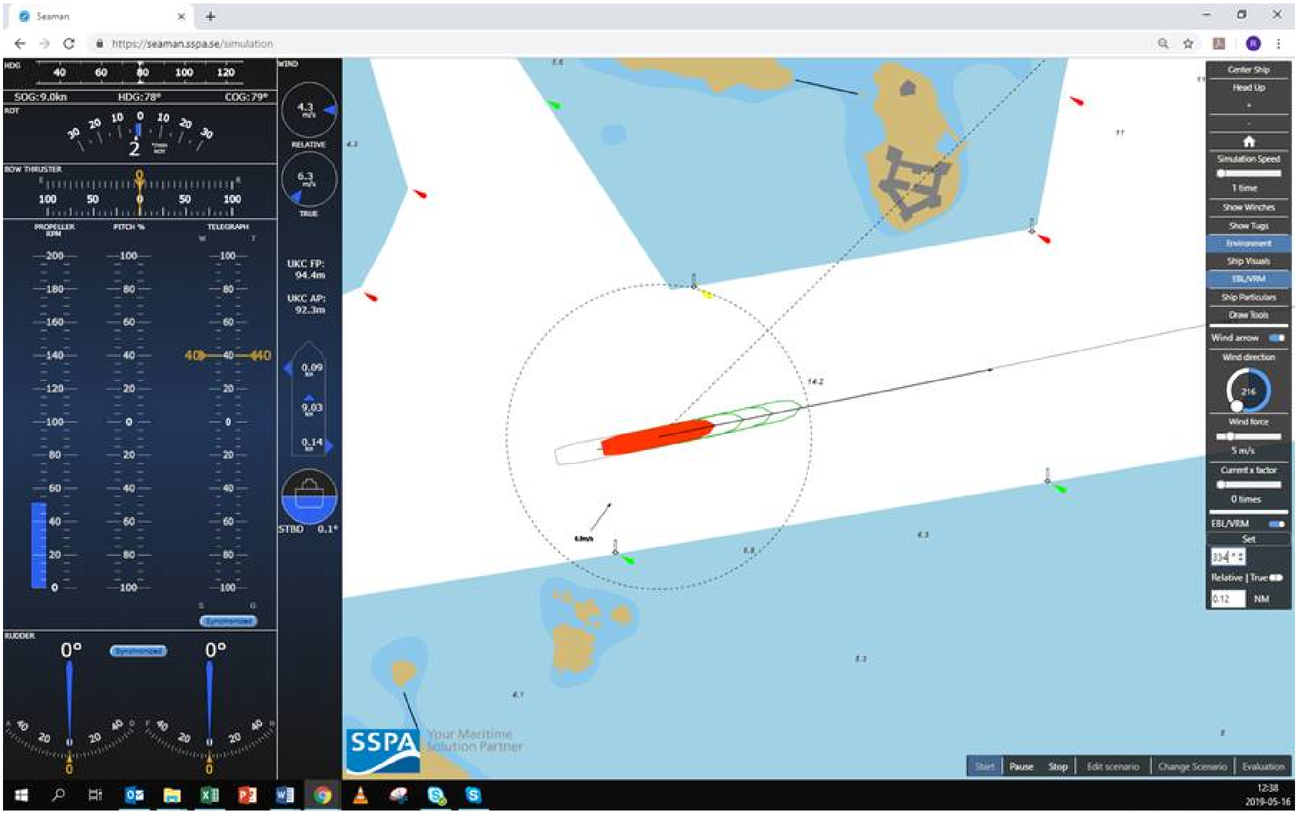

Figure 1. Example of the simulation web page from Seaman Online™.

Seaman Online™ is an extension of an existing simulation software at SSPA Sweden AB which has been used as the company's core numerical simulation software for around four decades in a number of different capacities, such as full-mission bridge simulation, fast-time simulations, Monte-Carlo simulations, among others. The software is based on the company's extensive knowledge of hydrodynamics and other operational aspects associated with ship manoeuvring. Other extensions of this core software are, for instance, the 2D and 3D bridge visualizations and the conning display used at the organization's full-mission bridge simulator, for training and testing purposes. The interface of the conning display was redesigned in 2015 in the context of a European Commission project, CyClaDes [www.cyclades-project.eu], through a human-centred design process where user involvement was sought for design input to create a more usable interface (Costa, Holder, & MacKinnon, 2017). Seaman Online™ is the most recent extension of SSPA's existing core simulation software and was also influenced by the work done during this human-centred design process and by further user feedback during other full-mission simulation projects.

The purpose of developing Seaman Online™ was to increase the availability of a ship manoeuvring training tool through a web browser, to allow for bulk training of students taking e.g., a course in vessel manoeuvring, or of professional bridge officers or pilots. Each simulation on Seaman Online™ can be customized for specific situations and learning objectives. Generally, the tool involves four modules:

- Ship dynamics modelling (how ships react under certain forces, e.g., shallow water effects, weather and currents, engine, mooring and tugboat dynamics).

- 2D birds-eye visualization of the Electronic Navigational Chart (ENC) adhering to the International Hydrographic Organization's (IHO) S-52 standard, and of visual parameters such as wind arrows and speed vectors.
- Analysis (an evaluation page of the simulation results, including qualitative and quantitative feedback to users about their manoeuvring exercise performance and ship dynamics. A student can flag her/his evaluation page to give the instructors access to the results).
- Administration (an administration portal where the instructor can design new training scenarios based on the available ports and ships, see the enlisted students and groups, assign specified scenarios/exercises to specific students/groups, receive students' evaluation pages and comments, and submit feedback to them).

Usability and User Experience

The employment of human-centred design principles, as mentioned earlier, helps to ensure that a product becomes more usable to the target user group (Grech et al., 2008; ISO, 2010; Maguire, 2001) in achieving intended tasks and goals with efficiency, satisfaction and effectiveness (ISO, 2002, 2010). A usable product can thus promote productivity and reduce the propensity for errors (Maguire, 2001).

The practice of usability evaluation methods is about having users/subject-matter experts inspect the usability-related aspects of a product design and user interface (Hornbæk, 2006; Jordan, 1998; Lewis, 2014; Nielsen & Mack, 1994), supporting the human-centred design principles (Jordan, 1998; Maguire, 2001) and capturing user experience and perceptions (ISO, 2010). A lack of user participation/representation might result in lower user acceptance (Norman, 2013). Usability evaluations can resort to a number of quantitative and/or qualitative methods, from questionnaires to interviews, to performance-related measurements, etc. (ISO, 2002).

Study Aim

In order to assess proof of concept and use experience of Seaman Online™ as part of the resources of a university course, its first-time implementation in this context was followed up by an online questionnaire for the students. The tool implementation and questionnaire results were then discussed among the course instructors involved and the members of the tool-providing organization (the tool developer and a researcher) at two debriefing sessions. The aim was to obtain (a) feedback about the usefulness of the tool in manoeuvring training; (b) design feedback for its further improvement and usability; and (c) feedback on how to best incorporate it into the programme curriculum in coming academic years for improved user experience.

METHOD

SSPA Sweden AB and Chalmers University of Technology are collaborating organizations in Gothenburg, Sweden. The division of Maritime Studies at Chalmers has for over a decade been using an older version of SSPA's simulation software on stationary desktop computers in their desktop simulation room for ship manoeuvring education purposes. Once SSPA began to ideate Seaman Online™, SSPA and the maritime simulation instructors at Chalmers came into contact to implement it as an additional resource and a replacement of the older software for student education in a course within the Master Mariner programme.

After the first version of Seaman Online™, Chalmers course instructors submitted to SSPA design requests that would better fit their needs and the course, helping SSPA to generically refine the design before the first-time implementation at the institution.

Tool Implementation

Context

The course in which Seaman Online™ was made available to the students as a resource was the compulsory "*Ship handling and navigation in confined waters*" course, which is part of the third-year curriculum of the four-year bachelor's programme for Master Mariner at Chalmers University of Technology. The course ran from January-March 2019. The students were provided with the tool through a university-purchased license and individual student accounts, during the whole duration of the course. Besides access to this tool, the students had compulsory instructor-led exercises in navigating in confined waters, anchoring and berthing manoeuvres using both Chalmers' desktop simulators (a room with five desktop stations) and bridge simulators (five part-mission bridge rooms).

The scope of the course is to gain knowledge and skills in the following main topics:

- Applied hydrodynamics (IMO manoeuvre tests, shallow water effects, ship interactions, etc.).
- Manoeuvring characteristics of different ships including the controllable, semi-controllable and uncontrollable forces involved in ship handling.
- Planning, executing and monitoring passages in confined waters such as archipelagos (blind

pilotage techniques on radar, controlled turns, etc.).

- Manoeuvring large ships with and without the use of tugboats.

Sample

The class was comprised of 32 students, of which 3 were female, and ages ranged from 21-39 years old. The students had at least five months (approx.) of prior experience onboard vessels as cadets by this time in the programme (which does not necessarily imply any experience in manoeuvring a ship at this stage). Out of the 32 students, 23 answered the voluntary questionnaire. No measurable feedback was collected from the remainder of the students.

There were several instructors involved in this course, of which two used the tool with the students (including the course coordinator). The instructors were experienced master mariners.

Familiarization and Support

For familiarization, the course coordinator produced two video tutorials for the students to watch as preparation before using Seaman Online™ in four course assignments. The first video demonstrated the basic principles of the tool's simulations and the second video demonstrated tool's simulations with the use of tugboats (see Figure 2 and Figure 3 as examples). The tool was also shortly introduced during a lecture (going through the same content as in the video tutorials), and the course coordinator also pre-programmed a special familiarization scenario within the tool. For tool support throughout the course, the students could pose questions and/or report issues to the instructors, who would get direct support from the tool developer when needed.

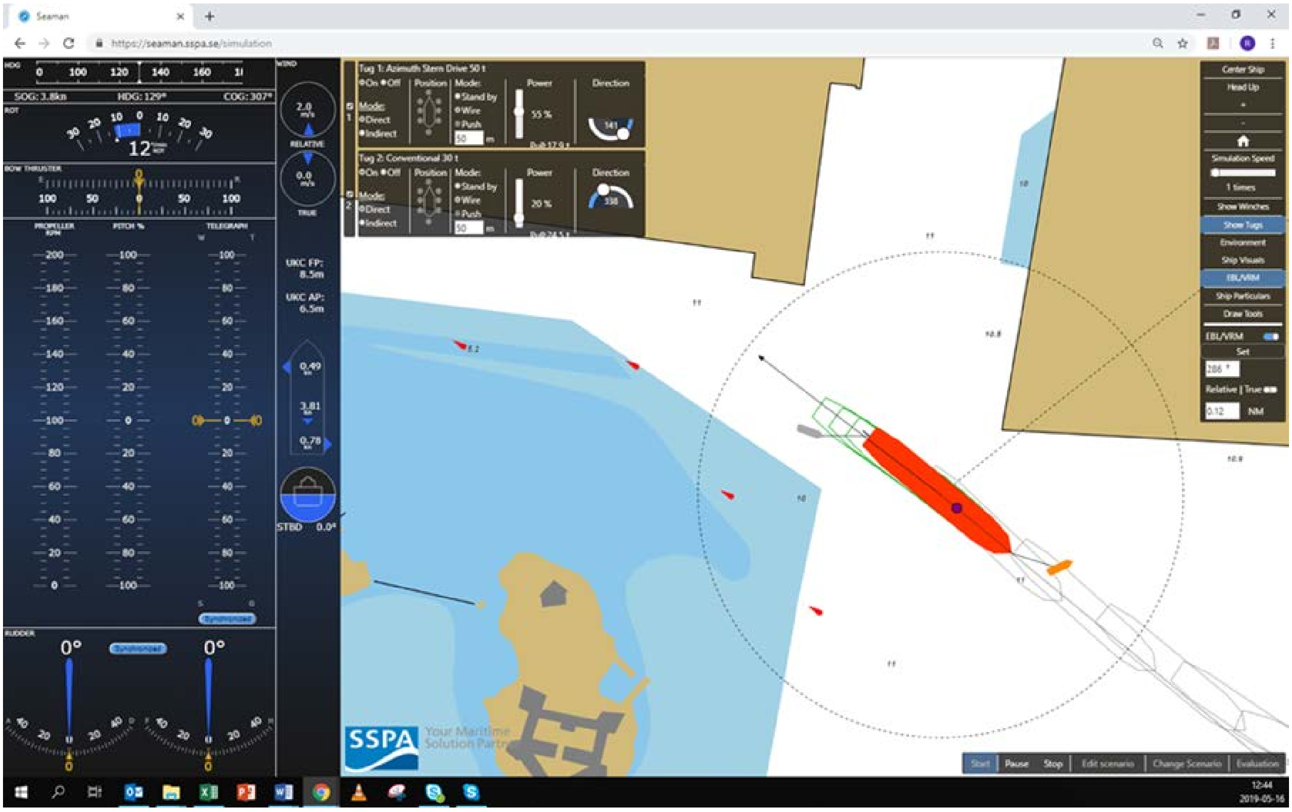

Figure 2. Example figure from the second familiarization video tutorial, demonstration with tugboat assistance.

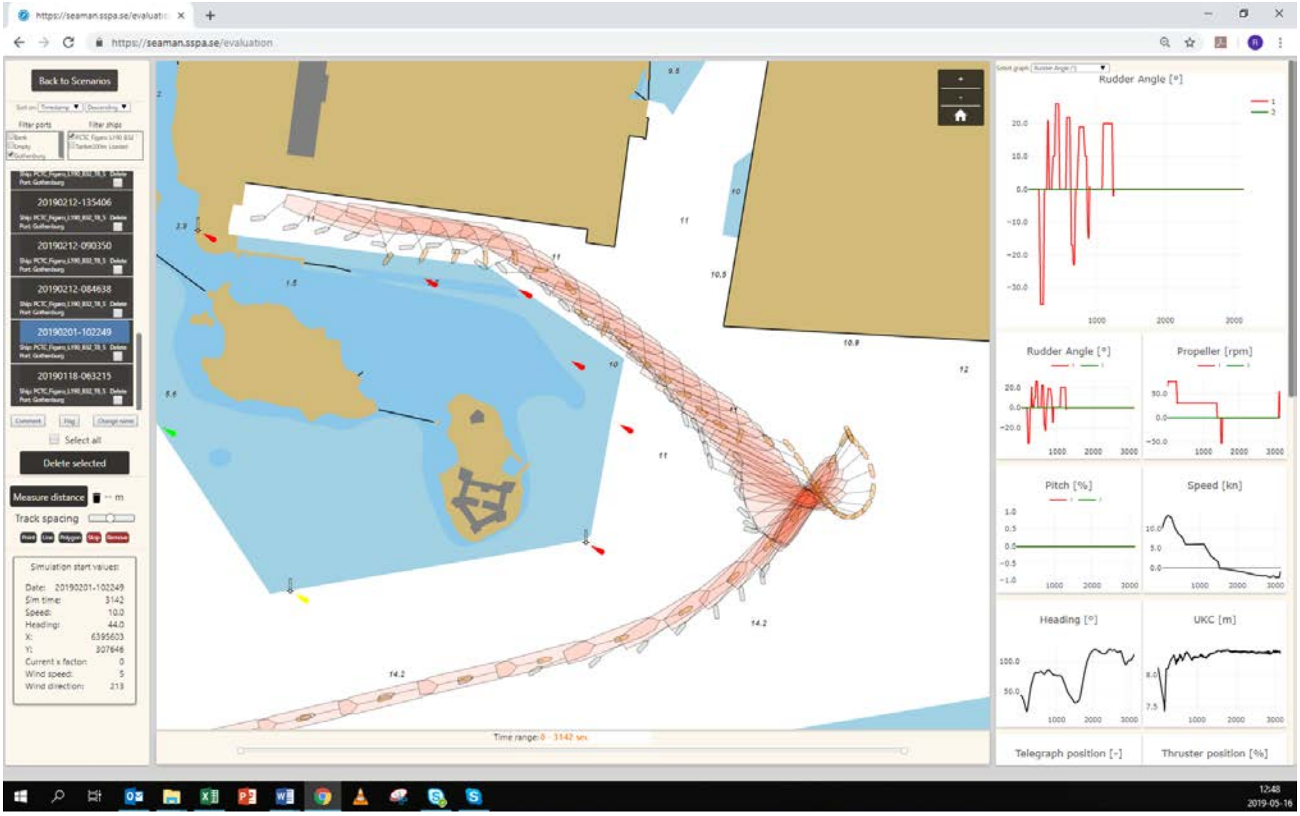

Figure 3. Example figure from the second familiarization video tutorial, evaluation page.

Instructed Assignments

Following the established course syllabus and educational goals, the course coordinator pre-programmed into the tool a number of exercise scenarios for the students to perform specific manoeuvres (one familiarization scenario (without tugboats), four exercises that the students were instructed to complete within the course, and an additional manoeuvre training scenario (with the possibility to connect to tugboats)). For each of the four exercises, the students received directives (description and goals) from the instructors (see Table 1).

Table 1. List of instructed assignments pre-programmed into Seaman Online™ for the students to perform specific manoeuvres.

Assignment	Description/Goals
Assignment 1 (IMO turning circle test with a tanker, in deep and in shallow waters)	The goal of this exercise was to understand the difference in the turning ability of a ship in deep and in shallow waters, and to assess whether the vessel fulfilled the IMO criteria regarding the turning tests for both cases.
Assignment 2 (ship interactions – meeting, overtaking; squat and bank effects)	The goal of this exercise was to experience and appreciate the effect of interaction and its forces on a ship's behaviour, and to practice controlling a ship under interaction effects.
Assignment 3 (berthing a PCTC)	The goal of this exercise was to safely manoeuvre the vessel to berth 712 Älvsborgshamnen without the use of tugboats. (*this exercise was assigned with the intent of preparing the students for the later similar exercise in the bridge simulators*)
Assignment 4 (berthing a PCTC with the use of tugboats)	The goal of this exercise was to understand (a) the capability and limitations of tugboats using "indirect mode" assistance, (b) the forces on the tug rope using "indirect mode", and (c) the difference between "static bollard pull" and "dynamic bollard pull", as well as to be able to use different techniques for port tugboat towing and to safely manoeuvre the PCTC vessel from Gäveskär to berth 712 Älvsborgshamnen.

After performing each exercise on Seaman Online™, the logged data from the run was graphically presented on the evaluation page. The students were asked by the instructors to reflect on relevant information on their evaluation pages and write a short analysis of the manoeuvres and ship dynamics for each exercise. Subsequently, the tool's evaluation pages were saved and flagged by the students to make them accessible to the instructors for assessment and grading. The instructors would revert to the students with feedback on their evaluation pages and written analyses when needed.

Data Collection

At the end of the course, the students were asked to voluntarily evaluate their use experience of the tool and instructed assignments through a short online questionnaire produced and administered through the SurveyMonkey online service. The questionnaire was developed for this context (Fife-Schaw, 1998) by the course coordinator in collaboration with the members of the tool-providing organization (the tool developer and the researcher). The questionnaire consisted of ten questions, closed- and open-ended (combining qualitative and quantitative data (Creswell, 2014; Creswell & Clark, 2011)):

- **Q1** – How difficult was it to use Seaman Online™? (Likert scale from 1 "*Very difficult*" to 5 "*Very easy*") Please give an example of what was difficult.
- **Q2** – How satisfied were you with the stability of Seaman Online™ (e.g., lagging issues, crashes, etc.)? (1 "*Very satisfied*" to 5 "*Very dissatisfied*") Please give an example of any problems encountered.
- **Q3** – How much time did you spend using Seaman Online™? (*1-5 hours; 6-10 hours; 11-15 hours; 16-20 hours; 21-25 hours; more than 26 hours*) Please also comment on how much you used Seaman Online™ to test other manoeuvres not related to the given tasks.
- **Q4** – On which exercise did you spend most time? (*Exercise 1 (IMO turning circle test deep and shallow waters); 2 (interaction and bank effects); 3 (berthing PCTC); 4 (berthing PCTC with tugs)*) Comment.
- **Q5** – Which exercises did you consider as most useful and which ones least? Why?
- **Q6** – How helpful was Seaman Online™ in your learning experience with regard to understanding the effects of shallow water, interaction and bank effects? (1 "*Extremely valuable*" to 5 "*Not at all valuable*") Comment.
- **Q7** – How helpful was Seaman Online™ in your learning experience with regard to manoeuvring ships alongside with and without tugs? (1 "*Extremely helpful*" to 5 "*Not at all helpful*") Comment.
- **Q8** – How useful did you find the data and graphs on the "evaluation page" when analyzing your simulation runs? (1 "*Extremely useful*" to 5 "*Not at all useful*") Please state which information on the evaluation page was most useful and what information you were missing.
- **Q9** – What are the things that you like most about Seaman Online™?
- **Q10** – What are the things that you would most like to improve in Seaman Online™?

Data Analysis

The online questionnaire service used recorded automatically all student responses and provided simple descriptive statistics (frequencies) on the closed-ended questions. These results, along with the responses from the open-ended questions Q5, Q9 and Q10 and the qualitative commentary on all remaining questions, were later discussed during two debriefing sessions: the first with the instructors and the tool developer, focusing on aspects of the design and function of the tool; and the second with the instructors and the researcher from the tool-providing organization, following up on the design of the tool, its usefulness for both students and instructors, and implementation with the students in the context of the university course. Both sessions were audio-recorded and/or documented/annotated. The collected qualitative data from both the questionnaire and the debriefings were then analysed by the researcher in terms of recurring answers/aspects (Creswell & Poth, 2018; Joffe & Yardley, 2004) of interest for aims (a) to (c) of this paper (e.g., the advantages of the tool, such as flexible use; needed design improvements, such as lagging and crashing; more instruction and debriefings needed in implementation).

RESULTS

The questionnaire results show (see Table 2 for descriptive statistics) that 73.91% of the respondents claimed to spend between 1-10 hours using Seaman Online™, whereas the remaining reported to spend 11 hours or more on it. It is also known that 52.17% of the respondents perceived Seaman Online™ as fairly easy to use, whereas 30.43% did not have a specific opinion and 17.39% perceived it as difficult. The reported difficulties ranged from getting familiarized with the layout and the controls of the tool's interface, zooming in on the chart (especially important considering that laptop screens are relatively small, and an additional larger monitor could provide a better experience), or experiencing a delayed response of the system, or even the crashing/freezing of the system. In fact, lagging (particularly when changing speed/thrust using specific internet browsers, or using the 'head-up' chart setting or bow thrusters) and crashing/freezing (especially after pausing and resuming an exercise) were the most commonly reported tool stability issues. This helps to explain the 21.74% dissatisfaction rate with regards to the stability of the tool and may also explain the 34.78% of "neither satisfied nor dissatisfied" responses. Still, 43.48% reported being satisfied with the stability of the tool.

Table 2. Overview of the quantitative questionnaire results.

Closed-ended question	Response frequencies
Q1	0.00% (0/23) "*Very difficult*" 17.39% (4/23) "*Difficult*" 30.43% (7/23) "*Neither difficult nor easy*" 39.13% (9/23) "*Easy*" 13.04% (3/23) "*Very easy*"
Q2	4.35% (1/23) "*Very satisfied*" 39.13% (9/23) "*Satisfied*" 34.78% (8/23) "*Neither satisfied nor dissatisfied*" 13.04% (3/23) "*Dissatisfied*" 8.70% (2/23) "*Very dissatisfied*"
Q3	34.78% (8/23) "*1-5 hours*" 39.13% (9/23) "*6-10 hours*" 17.39% (4/23) "*11-15 hours*" 8.70% (2/23) "*16-20 hours*" 0.00% (0/23) "*21-25 hours*" 0.00% (0/23) "*more than 26 hours*"
Q4	4.35% (1/23) "*Exercise 1 (IMO turning circle test deep and shallow waters)*" 4.35% (1/23) "*Exercise 2 (interaction and bank effects)*" 69.57% (16/23) "*Exercise 3 (berthing PCTC)*" 21.74% (5/23) "*Exercise 4 (berthing PCTC with tugs)*"
Q6	4.35% (1/23) "*Extremely valuable*" 60.87% (14/23) "*Very valuable*" 30.43% (7/23) "*Somewhat valuable*" 4.35% (1/23) "*Not so valuable*" 0.00% (0/23) "*Not at all valuable*"
Q7	13.04% (3/23) "*Extremely helpful*" 65.22% (15/23) "*Very helpful*" 13.04% (3/23) "*Somewhat helpful*" 4.35% (1/23) "*Not so helpful*" 4.35% (1/23) "*Not at all helpful*"
Q8	0.00% (0/23) "*Extremely useful*" 43.48% (10/23) "*Very useful*" 43.48% (10/23) "*No opinion*" 13.04% (3/23) "*Not so useful*" 0.00% (0/23) "*Not at all useful*"

Other important aspects reported referred to perceived flaws in the realistic representation of ship behaviour, namely due to wind, speed or thruster changes. The instructors also detected an unrealistic tugboat model and behaviour when using the "indirect mode". Students reported that there seemed to be a discrepancy in ship behaviour and wind effects between Seaman Online™ (especially when performing exercise 3) and the bridge simulators when performing a very similar exercise. Exercise 3, besides having been considered the most fruitful exercise of all four, was also the one where most respondents (69.57% of them) reported spending the longest time compared to the other exercises. Some considered it to be harder to perform on Seaman Online™ than in the bridge simulators, so much so that a student even suggested this exercise should be performed only in the bridge simulators rather than in Seaman Online™. This discrepancy in ship behaviours and difficulty levels could be later explained by the instructors at a debriefing session by the fact that Seaman Online™ was presenting more realistic wind (i.e., including wind gusts) compared to the exercise run in the bridge simulators where the wind speed was set as constant (in addition, the more realistic feel of the bridge simulators compared to Seaman Online™ could have potentially caused an influence as well). This discrepancy in wind settings had initially not been noticed by the instructors and some of the respondents' comments indicated that it had not been noticed by them either.

The usefulness of the graphs and information presented on the evaluation page after each exercise received mixed reviews (43.48% perceived it as "very useful" and 43.48% had "no opinion"). Negative comments revolved mostly around (a) the difficulty of interpreting some graphs and information provided on the evaluation page (the instructors referred specifically to the terminology and power units being used), and (b) the absence of other information that the respondents suggested would be good to have (e.g., a graph about the ship's squat effects, a circle radius function rather than a simple line to measure distances, and a playback function to be able to rerun an animation of their own exercises once completed). In terms of advantages, the respondents referred to the evaluation page as a good complement to see all hydrodynamic forces and how they affected the ship. The instructors suggested at a debriefing adding an element of evaluation throughout the exercise execution as well, namely live force vectors on the screen, representing bank and interaction forces on the ship.

On a general level, the respondents perceived the online ship manoeuvring training tool as a useful complement to the desktop and bridge simulators, and an opportunity to test manoeuvres and situations that they would otherwise not have the possibility to test in the desktop or bridge simulators or onboard vessels. One of the preferred aspects was that the tool can be used from home, without having to commute to the university or wait for available timeslots to use the simulation rooms for simple manoeuvres or assignments. Overall, 65.22% of the respondents found the tool to be really valuable for learning about shallow water and bank effects and ship interactions, as well as 78,26% found it to be really helpful for manoeuvring with and without tugboats. There were suggestions by the respondents to be able to connect the online tool to the desktop and bridge simulators at the university, and possibly allowing for multi-player scenarios.

The online tool was seen by the instructors as a good replacement of the old software on stationary computers and a complement to the other available resources (the course coordinator even considered it a better tool for training e.g., ship interactions, compared to the desktop or bridge simulators), facilitating that the students do specific course assignments in a more flexible manner to learn about manoeuvring before moving on to the ship handling simulation exercises in the bridge simulators. The tool was also used in class, during a tugboat manoeuvring lecture, as a medium for the instructors to visually demonstrate to the students ship manoeuvres while explaining them verbally.

DISCUSSION

The aim of this study was to obtain (a) feedback about the usefulness of the tool in manoeuvring training; (b) design feedback for its further improvement and usability; and (c) feedback on how to best incorporate it into the programme curriculum in coming academic years for improved user experience.

Study Aim (a). Overall, based on the results of the questionnaire, the majority of the respondents had a positive outlook on the tool for individual technical training of manoeuvring, ship interactions and hydrodynamic effects. It not only provided more flexible individual training for the students but was also perceived by the instructors as a new layer of education, evaluation and feedback within the course curriculum, for stepwise simulation-based training with other available simulation devices/facilities. There is even potential in the tool to be used as a medium for communication and exchange between instructors and students during lectures, as a visualization facilitator.

Study Aim (b). In terms of design improvements, issues such as getting familiarized with the layout and the controls of the tool's interface, zooming in on the chart, using the tool on a laptop's small screen, experiencing tool lags and crashes/freezes or imprecise tugboat model behaviour, interpreting and adding data to the evaluation module, among other issues and suggestions, were pointed out. These are aspects of the usability and maturity of the tool to be refined for further improved use experience. For example, with regards to the controls/keyboard input possibilities, the lagging and crashing/freezing of the system, it was suggested that these should either be technically resolved or clearer user instructions should be provided on the screen on how to use or what to expect from the system (e.g., what system requirements the tool has in order to function properly, or show a count-down clock of how long an exercise can be paused and resumed before it is erased). When properly designed, simpler and more cost-effective simulation devices such as Seaman Online™ can be a successful training alternative and complement to more complex full-mission simulations (Beaubien & Baker, 2004).

Study Aim (c). Results such as (a) the misunderstanding of ship behaviour and the difficulty levels completing exercise 3 with wind effects, (b) the perception of the tool's fidelity level being lower than that of the bridge simulators, or (c) the suggestion to add a multi-player function are all indicative of the need to brief, clarify and debrief the students about the purpose and the boundaries of the simulation device in terms of the course curriculum objectives, in conjunction with the other simulation devices made available in the course, in order to maximize the learning opportunities. This can be re-emphasized when performing debriefings with the students after each exercise. Debriefings (Sellberg, 2017, 2018) can also gauge and ensure that the students do not learn something incorrectly, especially in such circumstances where they are doing simulation exercises outside of instructor supervision. It is also important to understand that a simulated environment may always have inconsistencies and limitations. This study, thus, suggests, that the effectiveness of the simulation technology will not only depend on what it is used for and how it is used (Beaubien & Baker, 2004), but also on how it is introduced to (as well as instructed, guided and debriefed) – and understood by – the trainees in terms of simulation objectives and boundaries, as this had an influence on the students' perceptions and experiences with the tool. Realism becomes then a product of the instructions as well, rather than of the intrinsic technical features of the simulator alone (Sellberg, 2018).

It is unquestionably essential to the training programme that the simulation device can mimic a real-life bridge scenario as realistically as needed for the specific training objectives and competencies it pertains to develop (even though it does not fully replace all onboard training) (IMO, 2017). However, in terms of expectation, experience and assessment, it is also important that the trainee fully understands how the simulation tool is meant to be used and what it is being used for (IMO, 2017), so that they are able to focus on the content of the training and future work practices rather than the form.

Assigning a very similar exercise to the students on two separate simulation devices as was done for exercise 3, for example, may pertain to the development of different skills (in fact, exercise 3 on Seaman Online™ was assigned with the intent of preparing the students for the later similar exercise in the bridge simulators), and this must be understood by the trainees in terms of differences and how they serve as a complement to each other within the course curriculum.

The goal of simulations is practice, reflection and feedback (Maran & Glavin, 2003). The instructors intended that different resources in the course would be used for different purposes and this had not necessarily been fully gathered by the students, which was a lesson learned in that instructions need to be clearer in this sense. The instructors' specific intentions and expectations with Seaman Online™ were that it should help the students to reflect on the behaviour of the ship – to execute a manoeuvre and observe and reflect on what happens in terms of hydrodynamic forces on the ship. This pertains to the individual development of the technical skill that is ship handling. Adding another layer to this tool (as was suggested by a respondent with adding a multi-player function, for example), may have made the scenarios more realistic, but potentially added unnecessary complexity and distraction to the trainee and diminished the control of the instructors over individual student assessment. Different levels of simulation throughout different points of the curriculum are normally required for training (Beaubien & Baker, 2004). At early stages of simulation-based training, one may prefer to simplify a certain task to exclude distractions, to then introduce layers of simulation complexity more gradually as to facilitate the acquisition of competencies and the transference of those competencies between the different levels of simulation and a real-life scenario. Complex simulation techniques have been found to be less suitable in basic skill training, and different types of simulation technologies can be used as a complement to each other to increase fidelity (Maran & Glavin, 2003), as was the intent during this implementation. If the instructors can capture through the tool the skills they want their students to develop, the technical fidelity level of the tool may become less important, especially when in combination with other types of simulation technologies.

CONCLUSIONS

Seaman Online™ is a novel web-based manoeuvring simulation training tool created with the intent of offering both students and professional mariners the possibility to safely practice ship manoeuvres in ports and confined areas from their personal computers. This paper describes the first-time implementation of this simulation tool in the context of a university course in a Master Mariner programme. The aim of this study was to assess proof of concept and use experience of Seaman Online™ as part of the course's resources and obtain (a) feedback about the usefulness of the tool in manoeuvring training; (b) design feedback for its further improvement and usability; and (c) feedback on how to best incorporate it into the programme curriculum in coming academic years for improved user experience. To address these goals, the implementation was followed up by an online questionnaire for the students and the results were then discussed among the course instructors and the tool-providing organization during two debriefings. Feedback pertaining to maturity and usability details and issues in the tool was obtained (e.g., getting familiarized with the layout and the controls of the tool's interface, zooming in on the chart, using the tool on a small laptop screen, experiencing tool lags and crashes/freezes or imprecise tugboat model behaviour, interpreting and adding data to the evaluation module), but most importantly the results revealed that additional attention must be put onto explaining to the students the simulation device in relation to the course curriculum, its objectives in conjunction with the other simulation technologies used, and its limitations. In conclusion, certain aspects of the design and implementation should be refined for the coming academic year, but, even as is, the usefulness and potential of the tool for individual technical training in manoeuvring, ship interactions and hydrodynamic effects were demonstrated.

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